UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/298,064	04/22/1999	GUANGCAI XING	2616-US/RTP/	1649

32588 7590 07/29/2003

APPLIED MATERIALS, INC.
2881 SCOTT BLVD. M/S 2061
SANTA CLARA, CA 95050

EXAMINER	
ZERVIGON, RUDY	
ART UNIT	**PAPER NUMBER**
1763	24

DATE MAILED: 07/29/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/298,064	XING ET AL.	
	Examiner	Art Unit	
	Rudy Zervigon	1763	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED. (35 U.S.C. § 133)
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *12 May 2003*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-7 and 17-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-7 and 17-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a)☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1)☐ Notice of References Cited (PTO-892)
2)☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3)☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
4)☐ Interview Summary (PTO-413) Paper No(s). _____.
5)☐ Notice of Informal Patent Application (PTO-152)
6)☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC §102/103

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1-4, 6, 7 rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over P. J. Matsuo et al[1]. P. J. Matsuo et al identically describe a plasma semiconductor processing apparatus that generates a microwave plasma remotely relative to the substrate's location (Section I, Introduction; Figure 1). Additionally, the variable length of the plasma delivery tube is assessed under numerous conditions such as etch rates (Section III.A.2, p.1803), reaction layer thickness (Section III.C.4, p.1809), atomic (neutral) and reactive (radical) species concentration (Section IV.B, p.1812).

Specifically, and to further illustrate the teachings of P. J. Matsuo et al, the researchers describe:

---

[1] *J.Vac.Sci.Technol.* A **15**(4), Jul/Aug 1997

i. a first reaction chamber ("downstream tubing/lining", "Applicator" box portion of "downstream tubing/lining", Figure 1)

ii. a gas source (fluoromethane, oxygen, nitrogen, Figure 1) coupled to the first reaction chamber to supply a nitrogen gas to the first reaction chamber

iii. an excitation energy source ("applicator, 2.45GHz", Figure 1) coupled to the first reaction chamber to generate a nitrogen plasma comprising nitrogen ions and radicals from the nitrogen gas

iv. a second reaction chamber ("processing chamber", Fig.1) adapted to house a substrate at a site in the second reaction chamber

v. wherein the first reaction chamber is coupled to the second reaction chamber and separated from the substrate site by a distance equivalent to the lifetime of the nitrogen ions (Figure 4) at a plasma generation rate such that the radicals react with the substrate in a process conversion step (film deposition, Refer to Figure 10(d) and section C.1 - "At point (d) N_2 is injected once more and the reaction layer thickness increases again.")

vi. the excitation energy source supplies energy having a microwave frequency to generate a plasma from the nitrogen gas (abstract, first sentence)

vii. The dimensions of the first reaction chamber ("...as the distance from the plasma to the etching region is increased...") are configured such that substantially all of the nitrogen ions generated by the nitrogen plasma are changed from an ionic state to a charge neutral state within the first reaction chamber (Section IV.B, p.1812; Figure 25)

viii. An apparatus (Figure 1) for exposing a substrate to plasma, comprising a first reaction chamber ("downstream tubing/lining", Figure 1)

ix. means for supplying a nitrogen gas (fluoromethane, oxygen, nitrogen, Figure 1) to the first reaction chamber

x. means for generating a plasma from the nitrogen gas ("applicator, 2.45GHz", Figure 1)

xi. the plasma comprising nitrogen ions and radicals (definition of plasma)

xii. a second reaction chamber ("processing chamber", Fig.1) having means for housing a substrate

xiii. means for providing the plasma to the second reaction chamber substantially free of nitrogen ions such that the radicals react with a substrate in a process conversion step (Section IV.B, p.1812)

Item v above appears to be implicitly taught according to Figure 4. As shown in Figure 4, there are non-zero etch rates up to 125cm of first reaction chamber lengths. As such, lifetime of the nitrogen ions, up to and including these distances, are sufficiently long enough so "that the radicals react with the substrate in a process conversion step". However, although P. J. Matsuo et al teach all the structural limitations as described above, Matsuo's operation of the provided structure (Figure 1), as described in the reference, is not completely clear in anticipation that Matsuo's operation can provide a separation between chambers such that the separation is

equivalent to the lifetime of the nitrogen ions at a plasma generation rate such that the radicals react with the substrate.

However, Matsuo states that the separation distance plays a major role in which reactive species survive and reach the processing chamber (Section III.B.2, Page 1803, second sentence) under the variable conditions of flow control ("Mass Flow Controllers"; Figure 1) and microwave power (Section II - Experimental).

In the event that Matsuo's apparatus does not anticipate a separation between chambers such that the separation is equivalent to the lifetime of the nitrogen ions at a plasma generation rate such that the radicals react with the substrate, Matsuo's processing parameters of tube length, flow control, and microwave power can be optimized to meet the claimed property and function.

It would have been obvious to one of ordinary skill in the art at the time the invention was made for Matsuo to optimize the operation (variable length, flow rate, microwave power, gas identity, pressure; Section II – Experimental Apparatus and Procedure) of the apparatus to provide a separation between chambers such that the separation is equivalent to the lifetime of the nitrogen ions at a plasma generation rate such that the radicals react with the substrate.

Motivation for Matsuo to optimize the operation of the apparatus to provide a separation between chambers such that the separation is equivalent to the lifetime of the nitrogen ions at a plasma generation rate such that the radicals react with the substrate is to form a desired film. Further, it would be obvious to those of ordinary skill in the art to optimize the operation of the claimed invention (In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980); In re Hoeschele , 406 F.2d

1403, 160 USPQ 809 (CCPA 1969); Merck & Co. Inc . v. Biocraft Laboratories Inc. , 874 F.2d 804, 10 USPQ2d 1843 (Fed. Cir.), cert. denied , 493 U.S. 975 (1989); In re Kulling , 897 F.2d 1147, 14 USPQ2d 1056 (Fed. Cir. 1990), MPEP 2144.05).

4. Claims 17-20 are rejected under 35 U.S.C. 102(b) as being anticipated by Mehrdad M. Moslehi (USPat. 5,082,517). Mehrdad M. Moslehi identically describe a plasma semiconductor processing apparatus that generates a microwave plasma remotely relative to the substrate's location (column 1, lines 5-15). The control of the composition of neutral and reactive species, and it's importance to plasma processing, is taught by Mehrdad M. Moslehi (column 1, lines 46-68; column 2, lines 37-42; column 4, lines 9-14; column 12, lines 56-68). Specifically, Mehrdad M. Moslehi describes a process conversion (column 4, lines 55-60) system where:

i. A system (Figure 1) for reacting a plasma with a substrate

ii. a first chamber (18, Figure 1)

iii. a gas source (12, Figure 1) coupled to the first chamber comprising

iv. constituents (12, Figure 1) adapted to react with a substrate (48, Figure 1)

v. an energy source (38) coupled to the first chamber

vi. a second chamber (24) configured to house a substrate for processing

vii. a system controller (40) configured to control the introduction of a gas from the gas source into the first chamber (column 12, lines 65 – column 13, line 14; column 13, lines 57-68, 33-43) and to control the introduction of an energy from the energy source (column 5, lines 43-52)

viii. a memory coupled to the controller comprising a computer readable medium having a computer-readable program embodied therein for directing operation of the system (column 5, lines 43-52; column 14, lines 3-20), the computer readable program comprising:

ix. instructions for controlling the gas source (column 14, 3-20) and the energy source (column 14, lines 3-20) to convert a portion of a gas supplied by the gas source into a plasma comprising plasma nitrogen ions and radicals (column 4, lines 9-14; column 10, lines 55-60, definition of plasma) and to deliver the plasma to the second chamber substantially (column 4, lines 9-14; column 11, lines 54-63; column 1, lines 46-52) free of nitrogen ions to react with a substrate in the second chamber in a process conversion step

5. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over P. J. Matsuo et al[2] as applied to claims 1-4, 6, and 7 above, and further in view of Yamazaki et al (USPat. 6,130,118). P. J. Matsuo et al identically describe a plasma semiconductor processing apparatus that generates a microwave plasma remotely relative to the substrate's location (Section I,

[2] *J. Vac. Sci. Technol.* A **15**(4), Jul/Aug 1997

Introduction; Figure 1). However, P. J. Matsuo et al does not describe a rapid thermal processing chamber as a second chamber.

Yamazaki et al describes a plasma reaction apparatus for film deposition (column2, lines 20-25). Specifically, Yamazaki et al describes a substrate housing rapid thermal processing (RTP) chamber (104, Figure 4; column 6, lines 9-15).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to substitute the P. J. Matsuo et al second reaction chamber for the Yamazaki et al substrate housing rapid thermal processing (RTP) chamber.

Motivation for substituting the P. J. Matsuo et al second reaction chamber for the Yamazaki et al substrate housing rapid thermal processing (RTP) chamber is drawn to the enhanced insulation and thermal conductivity of prepared films (column 6, lines 57-59).

Response to Arguments

6. Applicant's arguments filed May 12, 2003 have been fully considered but they are not persuasive.

7. Regarding item i above, it has been well established in prior action that Matsuo teaches both etching and film formation processes - page 1805 – "In general, the decrease in Delta indicates the formation of a progressively thicker modified layer on the unperturbed silicon.....The formation of another layer takes place now. The time constant for this formation is just under 10 s....", and last paragraph, left column through first paragraph right column.

Additionally, in response to applicant's argument that Matsuo does not teach deposition, a recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, as demonstrated above, then it meets the claim. In a claim drawn to a process of making, the intended use must result in a manipulative difference as compared to the prior art. See *In re Casey*, 152 USPQ 235 (CCPA 1967) and *In re Otto*, 136 USPQ 458, 459 (CCPA 1963).

8. In response to applicant's argument that Matsuo does not describe "nitrogen (either plasma or nitrogen ions) specifically being incorporated in a reaction layer", a recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. In a claim drawn to a process of making, the intended use must result in a manipulative difference as compared to the prior art. See *In re Casey*, 152 USPQ 235 (CCPA 1967) and *In re Otto*, 136 USPQ 458, 459 (CCPA 1963).

9. Applicant states that the Examiner addresses Applicant's claimed limitation of a "first reaction chamber is separated from a substrate site by a distance equivalent to the lifetime of nitrogen ions at a plasma's generation rate such that radicals react with the substrate in a film conversion step" by stating that said limitation is intended use (last paragraph page 6 - 7). On the contrary, and as resulting form the amendment filed prior to the present action, applicant's specification states that said distance of 12 inches (page 18) is met by Matsuo's variable tube length (Figure 4, 30.48cm = 12 inches).

10. In response to Applicant's request that the Patent Office "provide some evidence or teaching that allows it to assume the separation between Matsuo's plasma applicator and a substrate site is nitrogen ion free and provides radicals available to react with a substrate", it is noted that the features upon which applicant relies are not recited in the rejected claims. Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993). Further, the prior Office Action asserted:

"

Motivation for Matsuo to optimize the operation of the apparatus to provide a separation between chambers such that the separation is equivalent to the lifetime of the nitrogen ions at a plasma generation rate such that the radicals react with the substrate is to form a desired film. Further, it would be obvious to those of ordinary skill in the art to optimize the operation of the claimed invention (In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980); In re Hoeschele , 406 F.2d 1403, 160 USPQ 809 (CCPA 1969); Merck & Co. Inc . v. Biocraft Laboratories Inc. , 874 F.2d 804, 10 USPQ2d 1843 (Fed. Cir.), cert. denied , 493 U.S. 975 (1989); In rc Kulling , 897 F.2d 1147, 14 USPQ2d 1056 (Fed. Cir. 1990), MPEP 2144.05).

"

As such, at minimal, Matsuo's apparatus can be optimized to provide evidence and teaching that the separation between Matsuo's plasma applicator and a substrate site is nitrogen ion free and provides radicals available to react with a substrate as discussed above.

11. Applicant's position that Moslehi does not teach first and second chambers separated by a distance equivalent to "the lifetime of the nitrogen ions" is not convincing. Moslehi teaches a

"plasma density controller" influencing control over "the concentrations of activated nitrogen ions and neutral species in plasma." (column 4, lines 9-15) including the concentrations of activated nitrogen ions and neutral species of the gasses shown in Figure 1 that includes molecular nitrogen that is excited to a plasma state. Because Moslehi's plasma density controller is capable of controlling "the concentrations" of his activated nitrogen ions and neutral species in plasma, Moslehi's separation distance between his first and second chambers would necessarily be sufficient under operating conditions such that the distance would be equivalent to the lifetime of the nitrogen ions at a plasma's generation rate such that radicals react with the substrate in a film conversion step.

Conclusion

12. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Examiner Rudy Zervigon whose telephone number is (703) 305-1351. The examiner can normally be reached on a Monday through Thursday schedule from 8am through 7pm. The official after final fax phone number for the 1763 art unit is (703) 872-9311. The official before final fax phone number for the 1763 art unit is (703) 872-9310. Any Inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Chemical and Materials Engineering art unit receptionist at (703) 308-0661. If the examiner can not be reached please contact the examiner's supervisor, Gregory L. Mills, at (703) 308-1633.

JEFFRIE R. LUND
PRIMARY EXAMINER